1 222 258 617

Dr. rer. pol. Fabian J. Sting,
Diplom-Kaufmann – Management Science (Univ.),
Master of Science in Mathematik – Methoden und Modelle (Univ.)

## Flexible Sourcing

Operational Hedging, Diversification and Contracting under Supply and Demand Uncertainty

Dissertation submitted in partial fulfillment of the requirements for the degree of — Doctor rerum politicarum (Dr. rer. pol.) — to WHU - Otto Beisheim School of Management according to the Doctoral Degree Regularity from November 19th, 2003

Advisor: Prof. Dr. Arnd Huchzermeier, Chair of Production Management, WHU - Otto Beisheim School of Management

Co-Advisor: Prof. Dr. Olaf Korn, Chair of Corporate Finance, Georg-August-Universität Göttingen

November 15, 2010

## **Contents**

1	Intr	oduction	I		
	1.1	Motivation	1		
	1.2	Supply Chain Risk Management	3		
	1.3	Modeling Frameworks and Supply Chain Topologies	5		
2	Operational Hedging and Diversification under Exogenous Supply				
	Unc	ertainty	9		
	2.1	Introduction	9		
	2.2	Related Literature	11		
	2.3	The Model	13		
		2.3.1 Modeling Dual Investment and Flexible Production	13		
		2.3.2 Modeling Supply Uncertainty	14		
		2.3.3 Solving the Investment and Production Problem	15		
	2.4	Characterizing the Optimal Sourcing Strategy	17		
	2.5	How Optimal Solutions correspond to Resource and Uncertainty			
		Characteristics	20		
		2.5.1 Impacts on Optimal Sourcing Forms	20		
		2.5.2 Impacts on Optimal Quantities	26		
	2.6	Discretization of the Model: All-or-nothing supply uncertainty	28		
	2.7	Conclusion, Application and Extensions	32		
	2.8	Proofs	34		
3	Res	ponsive Capacity Hedges Against Interrelated Supply and			
	Den	nand Uncertainty	45		
	3.1	Introduction	45		
	3.2	Literature Review	47		
	3.3	Model	48		
	3.4	The Optimal Sourcing Strategy	52		
	3.5	How Optimal Sourcing depends on Interrelated Supply and			
		Demand Uncertainty	57		
	3.6	Extension: Endogenous Supply Uncertainty	60		

xii Contents

	3.7	Conclusion	
	3.8	Proofs	
	3.9	Mathematical Properties: Figures and Tables	
4	Con	tracting for Responsive Capacity under Supply and Demand	
		ertainty 83	
	4.1	Introduction	
	4.2	Literature Review	
	4.3	Model	
		4.3.1 Benchmark: The Integrated System	
	4.4	Firm Commitments, Supply Options, and Price-Only Contracts 91	
		4.4.1 Forced Compliance Regime	
		4.4.2 Voluntary Compliance Regime	
	4.5	Utilization-Dependent Price-Only Compensation for Backup Supply 101	
	4.6	Conclusion	
	4.7	Proofs	
5	Ma	nagerial Insights117	
Bibliography			
No	menc	lature	
Lis	t of T	ables	
Lis	t of F	igures	